DOCUMENT RESUME

ED 298 682 EC 210 615

TITLE	Brain Research: Implications for the Education of Exceptional Children. Abstract XV: Research & Resources on Special Education.
INSTITUTION	ERIC Clearinghouse on Handicapped and Gifted Children, Reston, Va.
SPONS AGENCY	Office of Special Education and Rehabilitative Services (ED), Washington, DC. Div. of Innovation and Development.
PUB DATE	Dec 87
CONTRACT	400-84-0010
NOTE	7p.
AVAILABLE FROM	ERIC/OSEP Special Project on Interagency Information Dissemination, Council for Exceptional Children, 1920 Association Dr., Reston, VA 22091 (free).
PUB TYPE	Book/Product Reviews (072)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Autism; *Brain Hemisphere Functions; *Evaluation Methods; *Learning Disabilities; Meta Analysis; Research and Development; *Teaching Methods; *Theory Practice Relationship

ABSTRACT

The one-page abstract summarizes "Brain Research: Implications for the Education of Exceptional Children," an ERIC Computer Search Reprint containing bibliographic information and abstracts of 115 documents. Citations are described in five sections: learning disabilities, autism, other learning handicaps, assessment techniques, and instructional techniques. Although some studies have found an unusual reliance on one hemisphere by the learning disabled, the relationship of these findings to learning disorders is unclear. Despite the popularity of hemispherically related explanations for learning disabilities, a review of research concluded that there are strong empirical arguments to the contrary. Studies of autism found some evidence of left hemisphere dysfunction as well as evidence of neurochemical disturbance. Studies of other learning handicaps (such as deafness, behavior disorders, handedness, brain damage) were less frequent. Work on assessment techniques includes tests and electrophysical measurement techniques used to determine hemispheric preference, identify neurological problems, and identify subtypes of learning disability. Most studies on instructional techniques stress that education currently emphasizes left brain activities and that greater use of right train and integrated activities should be fostered. Sixty-two footnotes are provided. (DB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ERIC CLEARINGHOUSE ON HANDICAPPED AND GIFTED CHILDREN

ERIC/OSEP SPECIAL PROJECT ON INTERAGENCY INFORMATION DISSEMINATION

RESEARCH & RESOURCES ON SPECIAL EDUCATION

ED298682

ABSTRACT XV
DECEMBER 1987

BRAIN RESEARCH: IMPLICATIONS FOR THE EDUCATION OF EXCEPTIONAL CHILDREN

Knowledge of the workings of the brain has been advanced by research from several perspectives in recent years. From a functional point of view, new research has yielded information about the ways that the brain's characteristics influence a person's methods of interpreting information from the outside world, thereby shaping perceptions. New techniques, such as CAT scans (computerized axial tomography) and nuclear magnetic resonance, have provided information on the brain's distribution of mass and the shape and size of its structures. From neurochemistry, information about the influences of brain chemicals has mushroomed. Electrophysiological techniques have allowed the brain's electrical transmissions to be traced externally, without invading the brain itself. The merging of information from these perspectives has provided a more complete picture of how and why an individual perceives, thinks, and behaves in his or her own unique manner. As applied to learning handicaps, this knowledge can be used to promote understanding of the ways these handicaps can impede learning and to increase the effectiveness of instruction.

Brain Research: Implications for the Education of Exceptional Children is an ERIC Computer Search Reprint containing bibliographic information and abstracts on 115 documents describing brain research and its application to special education. These documents are described in the five sections below: learning disabilities, autism, other learning handicaps, assessment techniques, and instructional techniques.

Many of the studies described in this collection concern the different functions of the left and right hemispheres of the cerebral cortex. According to this theory, the left hemisphere is associated with logical, sequential, and verbal functions, while the right hemisphere is associated with perceptions of the whole ("gestalt") and processing of visual and spatial information. Activity in one side of the brain is related to the use of the opposite hand and eye; for example, use of the left hand requires activity in the right brain hemisphere. Much recent research reflects a fascination with these differences, especially with regard to their role in the expression of specific disabilities and their effects on learning style.

LEARNING DISABILITIES

This category includes studies and reviews of research regarding the neurological basis for learning disabilities.[1] Several studies in this group explore learning disabilities in terms of theories of hemispheric differences. Although some studies have found an unusual reliance on one hemisphere or an unusual functional organization to be associated with learning disabilities, the relationship of these findings to learning disorders, for example, whether cause or symptom, is unclear. One theory of cerebral processing deficiencies in children with learning disabilities provides a framework for a neurodevelopmental model based on left/right hemisphere differences, and describes the application of the model with respect to the ways that hemispheric differences apply in the normal process of learning to read. The model is also applied to students with learning disabilities in reading, math, spelling, and social interaction.[2] Another document reviews research on cerebral asymmetry and its effect on scholastic achievement, reading disabilities, learning disabilities, and linguistic competence.[3]

A CAT scan study showed different mass distributions in the brains of subjects with dyslexia than in the brains of normal control subjects.[4] However, another CAT scan study found few CAT scan abnormalities even in neurologically impaired learning disabled children.[5]

Several studies indicate that students with learning disabilities rely predominantly on right hemisphere cognitive processing. For example, a review of dyslexia research reports that CAT scan studies found abnormal specialization of the right hemisphere to be a factor in developmental dyslexia;[6] another study investigated math disabilities and suggested that many children who have difficulty with arithmetic suffer from a neurological developmental lag rather than an underlying deficit. The study found that such children favor the right hemisphere, which serves spatial functions, rather than the left, analytic half of the brain.[7] Another document reports a study that collected EEG data from 12 young males with learning disabilities and sex- and age-matched controls. The study found that the learning disabled males predominantly used a visuospatial processing strategy (associated with right hemisphere preference).[8] Another study reports asymmetries in favor of right brain performance in 105 of 108 children referred to a clinic for reading disabilities.[9]

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

EC210615

The Council for Exceptional Children operates the ERIC Clearinghouse on Handicapped and Gifted Children under a contract with the Office of Educational Research and Improvement, U.S. Department of Education.

A review of current findings and theories concerning the neurological bases of dyslexia points to irregularities in the brain's left hemisphere and patterns of electrical activity.[10] Another study, which investigated math disabilities, assumed that there were dysfunctions in the left hemispheres of 24 learning disabled young males with verbal IQ deficiencies. The subjects were pretested using eight measures of convergent and divergent thinking, then assigned to 8 weekly 21-minute sessions of bilateral feedback or a no-training control condition. Posttests 2 months after the pretest indicated that the training produced baseline effects in the presumably dysfunctional left hemisphere and had an impact on arousal in task, suggesting remedial potential. Training the right hemisphere toward higher arousal and the left hemisphere toward lower arousal resulted in a notable improvement in arithmetic.[11]

Another viewpoint that emerges from research on hemispheric theory and learning disabilities is that inadequate specialization of functions between the hemispheres leads to an unusual organization of incoming information. Several studies indicate that certain functions which are normally the province of one brain hemisphere are processed by both hemispheres (bilaterally) in persons with learning disabilities. One report points out that two positions have been taken with regard to the brain and reading: that language skills are generally considered to be the function of the left hemisphere, and that very poor reading results may be related to bilateral spatial processing.[12] Another study found that poor readers fail to comprehend because of problems in organizing visual input, which seems intimately related to bilateralization of functions.[13] Another study's results indicated that learning disabled children were more bilateral on factors involving fine motor activity, listening, and fine motor foot preference.[14]

Other studies have postulated subtypes of learning disabilities. For example, a study involving 19 dyslexic, 10-11-year-old young males grouped them according to whether they showed left-ear advantage (p-type dyslexia, associated with an overdeveloped right hemisphere) or right ear advantage (1-type dyslexia, associated with an overdeveloped left hemisphere). Subjects received visual stimulation of the nonpreferred hemisphere, and results showed that the stimulation improved subjects' ability to read.[15]

Despite the popularity of hemispherically related explanations of learning disabilities, a review of research concluded that there are strong empirical arguments to the contrary.[16] Another review of research concluded that although these studies have advanced knowledge about factors that can affect performance on tasks associated with each hemisphere, they do not produce a conclusive picture of abnormal hemispheric functions in LD children.[17]

AUTiSM

The fascination with the differential functions of the left and right brain hemispheres is also reflected in research on autism. Studies in this collection found evidence of left hemisphere dysfunction in autistic subjects. One of these based its conclusions on administration of the Halstead-Reitan Neuropsychological Battery to autistic, brain damaged, and mentally retarded children. The study found that autistic subjects showed a pattern of greater left hemisphere dysfunction than either brain damaged or mentally retarded controls.[18] Another project studied 10 high functioning autistic young males. The researchers administered nine tests, including assessments of verbal ability, color form sorting, geometric design, rhythm judgments, rhyming, abstract reasoning, and tactual performance. When compared to mental- and chronological-age matched control groups, the autistic children's performance on "left hemisphere" tests was significantly poorer, while their performance on "right hemisphere" tests was at chronological age. The researchers concluded that autistic children are handicapped on tasks that require left hemisphere mediation, and that there is evidence for impairment of performance in areas traditionally considered to reflect frontal lobe involvement.[19]

Other studies identified various other brain locations as the site of dysfunctions associated with autism. One study that used CAT scans found gross abnormalities in 26% of the 27 autistic children studied.[20] A review of studies suggested that autism results from neuropathology in the temporal lobes of the brain.[21] Another study found a relationship between the symptoms of autism and the symptoms of dysfunction in the phylogenetically older cortex and striatum.[22]

A literature review of electrophysical studies and findings from a related experiment suggested that in autism, dysfunctions of the brainstem during the early postnatal period may have influenced forebrain development;[23] dysfunctions in early development are also cited by a review of studies of neuronal development which concluded that disruption probably occurs in the end stages of neuronal development.[24]

These authors also included a discussion of autism in terms of neurochemical disturbance. Another article on neurochemistry reviews studies of serotonin, dopamine, and norepinephrine metabolism as related to infantile autism.[25]

OTHER LEARNING HANDICAPS

Although fewer in number than articles on learning disabilities or autism, documents describing studies of other learning handicaps are also included in this collection. For example, one document presents 18 papers discussing central auditory processing disorders, covering physical and physiological aspects as well as diagnosis, treatment, and management.[26] A study in this category examined EEG Alpha and Beta activity in normal and deaf subjects, finding that there may be differences in brain organization between deaf subjects who signed at an early age, those who only used oral speech and reading to communicate, and hearing subjects.[27] Another article discusses brain laterality in signed and spoken language, and explores the hypothesis that right hemispheric cognitive processes underlie the establishment of meaning in language and in the processing of linguistic gestalts.[28]

Other studies investigated behavior disorders. The possibility of neuropsychological impairment in persistent delinquency was examined in a study that administered the Halstead-Reitan Battery and 12 additional neuropsychological tests to adolescents. Clinical interpretation of the test results of delinquent adolescents in comparison to nondelinquent control subjects revealed a greater percentage of abnormal profiles in the delinquent group (84% versus 11%); a specific site was implicated, with greater dysfunction in the nondominant (right) hemisphere.[29] Another study found that individuals with right hemisphere predominance are at greater risk for behavioral, as well as learning, disorders.[30]

Several studies on handedness are included in this group. One document discusses studies concerning left-handedness and immune disorders, migraine headaches, and learning disorders.[31] Another describes a study that examined handedness and cognitive functions in pervasive developmental disorders; left-handed children tended to have higher scores on a battery of cognitive measures than right-handed children.[32] A third study found that people who are predominantly left-handed suffer fewer motor problems associated with moderate brain damage than right-handed people.[33]

Another study of brain damage examined the effects of pre- versus postnatal cerebral lesions on verbal learning and memory. Results indicated that subjects with left hemisphere lesions had more verbal memory deficits, and these deficits were greater if the lesion was acquired after birth.[34] A study of children who had suffered unilateral skull fractures found that the degree of intellectual impairment was significantly associated with the severity of the trauma, and that neither the child's age at injury nor the brain hemisphere damaged had an effect on the pattern of cognitive deficit.[35]

ASSESSMENT TECHNIQUES

This category describes tests and electrophysical measurement techniques that can be used to determine hemispheric preference, discover neurological problems, and identify subtypes of learning disability. Included are a discussion of procedures that school psychologists can employ to assess learning disorders[36] and a primer for parents and other lay people that describes informal procedures for early identification of brain dysfunction.[37]

Brain Electrical Activity Mapping (BEAM), a noninvasive technology used to chart changes in electrical activity from one brain area to another, is described in this category. This document reports that BEAM has shown dyslexia to be a neurophysiological problem with specific brain areas of dysfunction, and that the BEAM technology could allow early identification of learning disabilities before they are manifested in school performance. The report states that BEAM is 80% to 90% successful in identifying subjects with learning disabilities.[38]

A number of documents in this category describe tests to determine hemispheric preference and learning style. One reports case studies that illustrate the basic principle of applying hemispheric theory, the long-term effects of differences in cerebral functions, and longitudinal information regarding intervention strategies.[39] A relatively new test, the Kaufman Assessment Battery for Children, is described,[40] and the validity of measures used to indicate students' orientation to left or right brain functions is examined.[41]

Other documents discuss the application of well-established tests to the study of hemispheric differences. Specifically, discrepancies between the verbal and performance scales of the WISC-R and the Weschler-Bellevue were investigated. For the WISC-R, results supported the notion that there is antagonism between hemispheres when scores are discrepant.[42] The study of the Weschler-Bellevue concerned whether the discrepancy between verbal- and performance-weighted scores is a more sensitive sign of lateralized brain damage than a discrepancy between verbal and performance IQ scores. Results did not support this notion.[43]

Finally, a study of the Luria-Nebraska Neuropsychological Battery used cluster analysis of the responses of learning disabled adults to identify three subtypes: those who had difficulty primarily in language; those who had difficulty with perception, attention, and motor skills that support language development; and those who did not have a clearly identifiable neurological basis for their relatively mild academic performance deficiency.[44]

INSTRUCTIONAL TECHNIQUES

Many documents in this collection express the theme that in general, education currently emphasizes left brain activities, and that greater use of instructional strategies to develop right brain and integrated activities should be fostered.[45] In this category, a number of articles examine, describe, and investigate such strategies. These techniques range from providing very simple experiences, such as exposure to art objects[46] and describing impressions in sensory terms of color, shape and texture,[47] through arts and crafts classes emphasizing imagery, sequencing, and pattern manipulation[48] to more complex techniques such as story drama, prediction mapping, and guided journeys.[49] For example, one document provides methods to link creativity and mental imagery with cognitive and affective insight by developing students' ability to think in metaphors. This approach includes an experiential learning model in four phases (focus, experience, assessment, and integration) and provides lesson plans on such topics as empathy, perspectives, security, and values classification.[50] Other documents discuss the advantages of word processors in teaching students composition and writing[51] and the use of manipulatives to improve mathematics performance.[52]

Some articles specifically concern students with learning disabilities, describing, for example, student characteristics that exhibit right brain orientation which may interfere with class management. The article discusses the beneficial side of such characteristics and offers management suggestions.[53] Another article discusses two right hemisphere approaches—raised lettering and the Loveless-Blau technique—to promote word learning by LD students.[54] The category also includes a general discussion of neuropsychological approaches to intervention in learning disabilities based on neurological organization, psycholinguistics, and perceptual motor skills.[55]

Information for teachers also includes a technique for using right brain functions to evaluate students' work[56] and a document that describes teaching styles in relation to students' learning styles. This document provides 35 activities to stimulate integrated information processing.[57]

Articles concerning the application of neuropsychology by school psychologists are included in this collection. One of these presents the rationale of neuropsychology and its use in better understanding and treating children with learning disabilities. Neuropsychological classifications of brain functions and behavior are presented in order to help school psychologists recognize cases appropriate for neuropsychological assessment.[58] Another article distinguishes between neuropsychology and other approaches used by school psychologists, and discusses whether the neuropsychological approach is useful in the education setting.[59] A third article reviews the integration and application of neuropsychology in the schools.[60]

Other topics addressed in this category address the theory that children's brains grow in spurts and plateaus[61] and the idea that computers could be used to help translate brain research findings into classroom practice specifically tailored to student needs.[62]

Brain Research: Implications for the Education of Exceptional Children is one of a number of ERIC Computer Search Reprints, extensive bibliographies on specific topics in special education produced by the ERIC Clearinghouse on Handicapped and Gifted Children. Each reprint includes 60 to 100 documents and provides an abstract summarizing each document. The documents are selected from searches of the ERIC (Educational Resources Information Center) and ECER (Exceptional Child Education Resources) data bases, which include over 500,000 journal articles and other documents concerning education.

This summary was derived from document abstracts listed in *Brain Research: Implications for the Education of Exceptional Children* and should not be considered exhaustive of the literature on brain research and its applications in special education. *Brain Research: Implications for the Education of Exceptional Children* is available for $11.75 ($10.00 to CEC members) from The Council for Exceptional Children, 1920 Association Drive, Dept. CS87 M, Reston, VA 22091-1589 (703/620-3660). Order Computer Search Reprint No. 542.

In the footnotes below and in the ERIC Search Reprint, ED numbers refer to ERIC documents, which are generally available from the ERIC system. EJ numbers refer to ERIC-indexed journal articles; the journal articles themselves can be obtained from the publisher or through a library. EC numbers refer to documents abstracted and indexed in the ECER data base; these documents can be obtained from the publisher (if the document is commercially published material) or University Microfilms International (if the document is a doctoral dissertation).

FOOTNOTES

1. John E. Obrzut and George W. Hynd, "The Neurobiological and Neurophysiological Foundations of Learning Disabilties," *Journal of Learning Disabilities, 16,* no. 9 (November 1983): 515–520 (ERIC No. EJ 293 195).

2. Byron P. Rourke, "Central Processing Deficiencies in Children: Toward a Developmental Neuropsychological Model," *Journal of Clinical Psychology, 4,* no. 1 (May 1982): 1–18.

3. Dirk J. Bakker, "Cognitive Deficits and Cerebral Asymmetry," *Journal of Research and Development in Education, 15,* no. 3 (Spring 1982): 48–54. (ERIC No. EJ 262 570).

4. Marjorie LeMay, "Are There Radiological Changes in the Brains of Individuals with Dyslexia?" *Bulletin of the Orton Society, 31* (1981): 135–141.

5. Martha Bridge Denkla et al., "Few CAT Scan Abnormalities Found Even in Neurologically Impaired Learning Disabled Children," *Journal of Learning Disabilities, 18,* no. 3 (March 1985): 132–135. (ECER No. EC 171 951).

6. David Harrill Roberts, *Neurological Processes and Reading Pathology: Knowing About Children and Reading Dysfunction,* (July 1982). (ERIC No. ED 218 600).

7. Raymond S. Dean et al., "Lateral Preference Patterns As a Discriminator of Learning Difficulties," *Journal of Consulting and Clinical Psychology, 49,* no. 2 (April 1981): 227–235. (ERIC No. EJ 245 440).

8. Paul Naour and Daniel Martin, *Verbal Deficit in Learning Disabilities: Electrophysiological Evidence for Visuospatial Processing Predominance,* (April 1984). Paper presented at the Annual Meeting of the American Educational Research Association.

9. B. Z. Harness et al., "Cognitive Profile of Children Referred to a Clinic for Reading Disabilities," *Journal of Learning Disabilities, 17,* no. 6 (June–July 1984): 346–352. (ECER No. EC 161 729).

10. John Langone, "Deciphering Dyslexia: The Brain," *Discover,* (August 1983): 34–39. (ECER No. EC 160 600).

11. Mark D. Cunningham and Philip J. Murphy, "The Effects of Bilateral EEG Feedback on Verbal, Visual-Spatial, and Creative Skills in Learning Disabled Male Adolescents," *Journal of Learning Disabilities, 14,* no. 4 (April 1981): 204–208. (ECER No. EC 133 209).

12. Edith G. Richards, "Neurological Implications in Reading Disability," *Journal of Research and Development in Education, 14,* no. 4 (Summer 1981): 50–53. (ERIC No. EJ 250 479).

13. Raymond S. Dean, "Cerebral Lateralization and Reading Dysfunction," *Journal of School Psychology, 18,* no. 4 (Winter 1980): 324–332. (ERIC No. EJ 240 090).

14. Raymond S. Dean et al., "Lateral Preference Patterns As a Discriminator of Learning Difficulties," *Journal of Consulting and Clinical Psychology, 49,* no. 2 (April 1981): 227–235. (ERIC No. EJ 245 440).

15. Dirk J. Bakker et al., "Effects of Hemisphere-Specific Stimulation on the Reading Performance of Dyslexia Boys: A Pilot Study," *Journal of Clinical Neuropsychology, 3,* no. 2 (July 1981): 155–159. (ECER No. EC 133 749). Also see William S. Sobotowiscz and James R. Evans, *Cortical Dysfunctioning in Children with Specific Reading Disability* (Springfield, IL: Charles C Thomas, 1982). (ECER No. EC 143 034).

16. Merrill Hiscock and Marcel Kinsbourne, "Laterality and Dyslexia: A Critical View," *Annals of Dyslexia, 32,* (1982): 177–228. (ECER No. EC 150 718).

17. John E. Obrzut and Carol A. Boliek, "Lateralization Characteristics in Learning Disabled Children," *Journal of Learning Disabilities, 19,* no. 5 (May 1986): 308–314. (ECER No. EC 182 478).

18. Geraldine Dawson, "Lateralized Brain Dysfunction in Autism: Evidence from the Halstead-Reitan Neuropsychological Battery," *Journal of Autism and Developmental Disorders, 13,* no. 3 (September 1983): 269–286. (ERIC No. EJ 293 190).

19. Wendy L. Hoffman and Margot R. Prior, "Neuropsychological Dimensions of Autism in Children: A Test of the Hemispheric Dysfunction Hypothesis," *Journal of Clinical Neuropsychology, 4,* no. 1 (May 1982): 27–41. (ECER No. EC 150. 536).

20. Christopher Gillberg and Pal Svendsen, "Childhood Psychosis and Computed Tomographic Brain Scan Findings," *Journal of Autism and Developmental Disorders, 13,* no. 1 (March 1983): 19–32. (ECER No. EC 151 330).

21. Bruce E. Hetzler and Judith L. Griffin, "Infantile Autism and the Temporal Lobe of the Brain," *Journal of Autism and Developmental Disorders, 11,* no. 3 (September 1981): 317–330. (ECER No. EC 141 248).

22. Ralph G. Mauer and Antonio R. Damasio, "Childhood Autism from the Point of View of Behavioral Neurology, *Journal of Autism and Developmental Disorders, 12,* no. 2 (June 1982): 195–205. (ECER No. EC 150 454).

23. Peter E. Tanguay and Rose Mary Edwards, "Electrophysiological Studies of Autism: The Whisper of the Bang," *Journal of Autism and Developmental Disorders, 12,* no. 2 (June 1982): 177–184. (ECER No. EC 150 452).

24. Roland D. Ciaranello et al., "Intrinsic and Extrinsic Determinants of Neoronal Development: Relation to Infantile Autism," *Journal of Autism and Developmental Disorders, 12,* no. 2 (June 1982): 115–145. (ECER No. EC 150 449).

25. Gerald Y. Young et al., "Clinical Neurochemistry of Autism and Associated Disorders," *Journal of Autism and Developmental Disorders, 12,* no. 2 (June 1982): 147–165. (ECER No. EC 150 450).

26. Elaine Z. Lasky and Jack Katz, eds., *Central Auditory Processing Disorders: Problems of Speech, Language, and Learning.* (Baltimore: University Park Press, 1963). (ECER No. EC 162 434).

27. Manjula Waldron et al., *EEG Alpha and Beta Activity in Normal and Deaf Subjects,* (April 1984). Paper presented at the Annual Meeting of the American Educational Research Association (68th, New Orleans, LA). (ECER No. EC 170 447).

28. David F. Armstrong and Solomon H. Katz, "Brain Laterality in Signed and Spoken Language: A Synthetic Theory of Language Use," *Journal of Visual/Verbal Languaging, 2,* no. 2 (Fall 1982): 17–36. (ERIC No. EJ 308 705).

29. Lorne T. Yeudall et al., "Neuropsychological Impairment of Persistent Delinquency," *Journal of Nervous and Mental Disease, 170,* no. 5 (May 1982): 257–265. (ECER No. EC 143 085).

30. John Stellern et al., "Neuropsychological Significance of Right Hemisphere Cognitive Mode in Behavior Disorders," *Behavior Disorders, 10,* no. 2 (February 1985): 113–124. (ECER No. EC 172 153).

31. Norman Gerschwind, "Biological Associations of Left-Handedness," *Annals of Dyslexia, 33,* (1983): 29–40. (ECER No. EC 170 202).

32. Deborah Fein et al., "Handedness and Cognitive Functions in Pervasive Developmental Disorders," *Journal of Autism and Developmental Disorders, 15,* no. 3 (September 1985): 323–333. (ECER No. EC 180 616).

33. B. Bower, "A Brain Damage Advantage for Lefties?" *Science News, 128,* no. 19 (November 9, 1985): 296. (ERIC No. EJ 328 684).

34. Faraneh Vargha-Khadem and Elizabeth Issacs, *The Effects of Early vs. Late Cerebral Lesions on Verbal Learning and Memory in Children* (April 1985). (ERIC No. ED 265 677).

35. Oliver Chadwick et al., "Intellectual Performance and Reading Skills after Localized Head Injury in Childhood," *Journal of Child Psychology and Psychiatry and Allied Disciplines, 22,* no. 2 (April 1981): 117–139. (ERIC No. EJ 244 468).

36. John E. Obrzut, "Neuropsychological Assessment in the Schools," *School Psychology Review, 10,* no. 3 (Summer 1981): 331–342. (ECER No. EC 133 940).

37. Marion F. Jurko, *Identifying the Neurologically Impaired Child: A Primer for Parents and Laypeople* (Springfield, IL: Charles C. Thomas, 1984). (ECER No. EC 170 797).

38. Michael W. Tortello, "Using Brain Electrical Activity Mapping to Diagnose Learning Disabilities, *Theory into Practice, 24,* no. 2 (Spring 1985): 95–99. (ERIC No. EJ 320 495).

39. Jack J. Fadely and Virginia N. Hosler, *Case Studies in Left and Right Hemispheric Function* (Springfield, IL: Charles C. Thomas, 1983). (ECER No. EC 152 255).

40. Raymond S. Dean, "Functional Lateralization of the Brain," *Journal of Special Education, 18,* no. 3 (Fall 1984): 239–256. (ECER No. EC 171 580).

41. Jule Dumbrower et al., "An Attempt to Determine the Construct Validity of Measures Hypothesized to Represent an Orientation to Right, Left, or Integrated Hemispheric Brain Function for a Sample of Primary School Children," *Educational and Psychological Measurement, 41,* no. 4 (Winter 1981): 1175–1194. (ERIC No. EJ 260 779).

42. Raymond S. Dean, "Cerebral Laterality and Verbal-Performance Discrepancies in Intelligence," *Journal of School Psychology, 17,* no. 2 (Summer 1979): 145–150. (ERIC No. EJ 202 841).

43. Dano A. Leli and Susan B. Filskov, "Actuarial Assessment of Wechsler Verbal-Performance Scale Differences as Signs of Lateralized Cerebral Impairment," *Perceptual and Motor Skills, 53,* no. 2 (October 1981): 491–496. (ERIC No. EJ 262 642).

44. Michael McCue et al., *Cluster Analysis of the Kuris-Nebraska Neuropsychological Battery with Learning Disabled Adults* (August 1985). (ERIC No. ED 268 744).

45. For example, see Gertrude M. Webb, "Left/Right Brains, Teammates in Learning," *Exceptional Children, 49,* no. 6 (April 1983): 508–515. (ECER No. EC 152 381); John T. Myers, "Hemispherity Research: An Overview with Some Implications for Problem Solving," *Journal of Creative Behavior, 16,* no. 3 (1982): 197–211. (ECER No. EC 151 810); Edward C. Smith, "Cultural Differences and Academic Achievement," *Pointer, 30,* no. 3 (Spring 1986): 28–31. (ECER No. EC 190 061); Ronald L. Rubenzer, *The Brain Owner's Manual: A Workshop in How to Reach Your Personal Best Through a Whole Mind Approach.* (ERIC No. ED 242 110). Regina G. Richards, *Innovative Right Brain Teaching Techniques.* (ERIC No. ED 246 632).

46. Virginia Barr-Johnson, "Challenging the Right Side of the Brain," *Creative Child and Adult Quarterly, 7,* no. 4 (Winter 1982): 218–225. (ERIC No. EC 151 258).

47. Win Wenger, "Creative Creativity: Some Strategies for Developing Specific Areas of the Brain and for Working Both Sides Together," *Journal of Creative Behavior, 15,* no. 2 (1981): 77–89. (ECER No. EC 140 115).

48. Therese O'Connor, "Exploring the Other Side of the Brain," *Perspectives for Teachers of the Hearing Impaired, 2,* no. 4 (March–April 1984): 12–13. (ECER No. EC 162 568).

49. Barbara J. Walker, "Right Brained Strategies for Teaching Comprehension," *Academic Therapy, 21,* no. 2 (November 1985): 133–141. (ECER No. EC 181 046).

50. Donald A. Sanders and Judith A. Sanders, *Teaching Creativity Through Metaphor: An Integrated Brain Approach* (New York: Longman, Inc., 1984). (ECER No. EC 161 764).

51. Mary Ann Aschauer and Fred D. White, *Towards a Marriage of Two Minds: The Word Processor and Natural Habits in the "Discovery" Stage of Composing.* (ERIC No. ED 243 129).

52. Evelyn M. VanDevender and Dale R. Rice, *The Effect of Three Types of Brain-Based Instruction on the Mathematics Achievement and Attitudes of Second Grade Students.* (ERIC No. ED 250 155).

53. Suzanne H. Stevens, "Differences to Celebrate," *ACLD News Brief,* no. 160 (May–June 1985, February 1985). (ERIC No. ED 259 493).

54. Harold Blau and Richard Sinatra, "Word Learning: Using the Right Brain," *Academic Therapy, 17,* no. 1 (September 1981): 69–75. (ECER No. EC 140 165).

55. John A. Zarske, "Neuropsychological Intervention Approaches for Handicapped Children," *Perceptual and Motor Skills, 53,* no. 2 (October 1981): 491–496. (ERIC No. EJ 262 572).

56. William R. Martin, *Evaluating on the Right Side* (1983). (ERIC No. ED 241 939).

57. Ronald L. Rubenzer, *Educating the Other Half: Implications of Left/Right Brain Research* (1982). (ERIC No. ED 224 268).

58. William H. Gaddes, "Neuropsychology, Fact or Mythology, Educational Help or Hindrance?" *School Psychology Review, 10,* no. 3 (Summer 1981): 322–330. (ERIC No. EJ 251 707).

59. Jonathan Sandoval and Randy M. Haapmanen, "A Critical Commentary on Neuropsychology in the Schools: Are We Ready?" *School Psychology Review, 10,* no. 3 (Summer 1981): 381–388. ERIC No. EJ 251 714).

60. George W. Hynd, "Rebuttal to the Critical Commentary on Neuropsychology in the Schools, *School Psychology Review, 10,* no. 3 (Summer 1981): 389–393. (ERIC No. EJ 251 715).

61. Virginia Barr-Johnson, "Challenging the Right Side of the Brain," *Creative Child and Adult Quarterly, 7,* no. 4 (Winter 1982): 218–225. (ERIC No. EC 151 258).

62. William J. Stewart, "Brain-Congruent Instruction: Does the Computer Make it Feasible?" *Educational Technology, 24,* no. 5 (May 1984): 28–30. (ERIC No. EJ 301 696).

ERIC's Special Project on Interagency Information Dissemination is designed to provide information about research in special education, in particular, research funded by the Division of Innovation and Development, Office of Special Education Programs, U.S. Department of Education. This product was developed by the ERIC Clearinghouse on Handicapped and Gifted Children under contract No. 400-84-0010 with the Office of Special Education Programs, U.S. Department of Education. The content, however, does not necessarily reflect the position of OSEP/ED and no official endorsement of these materials should be inferred.

ERIC CLEARINGHOUSE ON HANDICAPPED AND GIFTED CHILDREN
RESEARCH & RESOURCES ON SPECIAL EDUCATION
THE COUNCIL FOR EXCEPTIONAL CHILDREN
1920 ASSOCIATION DRIVE, RESTON, VA 22091